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"I SHOULD, BUT I DON'T FEEL LIKE IT": OVERCOMING OBSTACLES IN UPPER SECONDARY STUDENTS' SELF-REGULATION USING LEARNING ANALYTICS

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ABSTRACT

While research has been conducted on self-regulated learning in relation to learning analytics, there remains a knowledge gap regarding the obstacles secondary education students face in regulating their learning and how learning analytics can support their self-regulation. This paper investigates two questions: 1) What challenges do secondary education students experience in the process of regulating their own learning?, and 2) What information and data do secondary education students need to better regulate their own learning? We conducted a study at a mid-sized upper secondary school in middle Sweden, to better understand how these issues manifest among students. We analyzed data collected by the school twice annually between 2015 and 2022, and administered a questionnaire to 224 students to answer the research questions. Through descriptive statistics and a thematic analysis, we identify prevalent problems that students encounter, as well as the necessary information that is essential for scaffolding self-regulated learning. We discuss the implications of our findings for the design of systems that provide students with relevant data to enhance their learning experiences.

KEYWORDS

self-regulated learning; obstacles; learning analytics; scaffolding; secondary education

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Introduction

This story begins, as many do, as a tale of frustration. As teachers, we have been frustrated, at times exasperated, by the never-decreasing number of students who can't seem to get the job done on time. Missed deadlines, cramming just before tests, writing a whole essay the night of the deadline, extensions, procrastination, and bad planning – these are staples of our lives. The experiences led us to wonder – can Self-Regulated Learning (SRL) and Learning Analytics (LA) be part of the solution to this problem?

The importance of planning related to self-regulation is well known (Gollwitzer, 1999), and the problem with students being unable to plan, or focus on their work, is not a story unique to our experience, but something that permeates education everywhere. As one researcher notes: "The problems of distracted learning, as well as the associated solutions, are far deeper than meets the eye" (Schmidt, 2020, p. 286). It has been noted that while education often creates learning situations where SRL skills are needed (Bolhuis & Voeten, 2001; Dignath & Veenman, 2021), and that there are ways to teach SRL that affects learning and motivation positively (Dignath et al., 2008), schools rarely teach SRL skills in an effective manner (Dignath & Veenman, 2021). If schools are failing to teach students SRL skills, while still requiring it of them, there is a need to both further understand what problems students encounter, and to investigate other means of supporting SRL.

One such possible means of support is through the use of Learning Analytics, which offers ways to analyze and present data insights for students that may help them self-regulate (Lodge et al., 2018; Winne, 2022). While the research around SRL and LA is vast, most of it has been done in higher education (Heikkinen et al., 2023; Schwendimann et al., 2016), so there is a still a need for further investigation of these areas in primary and secondary education.

This study aims to understand where students in upper secondary school encounter problems in regulating their learning, which areas may be suitable for scaffolding using learning analytics, and what data is needed for such scaffolding. Thus we ask the following research questions:

- Research Question 1: What challenges do secondary education students experience in the process of regulating their own learning?
- Research Question 2: What information and data do secondary education students need to better regulate their own learning?

1 Self-regulated learning and learning analytics

Self-Regulated Learning (SRL) has over the last decades become important to the field of educational research (Schunk & Greene, 2017). According to Zimmerman, "self-regulated learners are persons who plan, organise, self-instruct, self-monitor, and self-evaluate at various stages during the learning process" (Zimmerman, 1986, p. 308).

There are several different models of SRL (Panadero, 2017; Puustinen & Pulkkinen, 2001), six of which were analyzed by Panadero (2017), who concludes that five of the six models can be said to include three phases of SRL, although their names and structure may differ. The three common phases are: 1. Preparatory phase, 2. Performance phase, and 3. Appraisal phase. For the purpose of this paper, Zimmerman's cyclical phase model of SRL (Zimmerman, 2000) will be used as a primary model for reference and analysis, and guides both the data collection and subsequent analysis. In this model the three phases mentioned above are called 1. Forethought, 2. Performance and 3. Self-reflection, where each phase has two subcategories, as seen in Figure 1 (Zimmerman & Moylan, 2009).

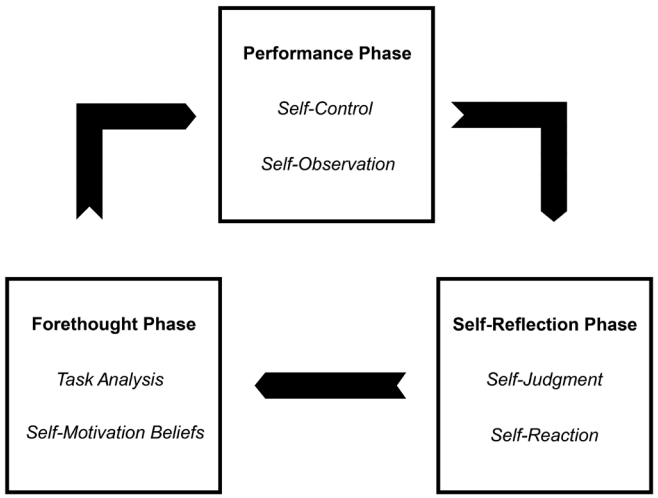

Figure 1
Cyclical phase model based on Zimmerman & Moylan (2009)

Zimmerman (1986) describes how one can become a self-regulated learner, implying that not everyone is, while Winne instead argues that SRL is ubiquitous (Winne, 1995) but not all learners regulate in ways that are suited

for the task, or they regulate at non-optimal times (Winne, 2005). Winne (2005) also suggests that scaffolding can help mediate this problem, and that learners need information (Winne, 2005, 2022), particularly process feedback, but they also need tools to become better self-regulated learners.

In attempting to scaffold students' SRL, it is imperative to know at what stage in the process the student needs scaffolding, which means looking at what problems the students encounter while regulating their learning. There are several examples of problems in the literature. Boekaerts (1999) points out that there are differences in students' abilities to handle goals, with some students seemingly unable to handle multiple goals and instead focusing on one goal at a time, meaning some goals may be postponed, and sometimes never even make it into the student's focus.

One way of scaffolding learners' SRL is to provide information. As students are developing their regulatory skills, they are often hindered by a lack of information and feedback that could guide their efforts (Winne, 2022), which is one central argument for the importance of using Learning Analytics for SRL development. The function of LA in this context can be, for instance, to provide students with feedback on their efforts, and suggestions for action based on analysis of previous students' actions and performance (Afzaal et al., 2021a, 2023).

The field of LA has grown alongside digitalization in education, and is most commonly defined as "[...] the measurement, collection, analysis, and reporting of data about learners and their contexts, for the purposes of understanding and optimizing learning and the environments in which it occurs." (Siemens, 2013, p. 1382), a definition that has been standing since the first International Conference of Learning Analytics in 2011.

In LA, a fair amount of work has been done on the intersection of learning analytics and self-regulated learning (Álvarez et al., 2022; Heikkinen et al., 2023; Matcha et al., 2020). In a systematic review Matcha et al. (2020) look at existing Learning Analytics Dashboards (LADs), and conclude that there are problems relating to user-centered design, that there is a lack of knowledge of, among other things, study strategies and tactics used by students, and that information provided to students as feedback should be presented in multiple forms. Álvarez et al. (2022) made another systematic review of LADs that points out that the links between functionality in dashboards and the processes that they are supposed to support are lacking. Heikkinen et al. (2023) point out that while there has been a recent trend toward a broader view, most studies of learning analytics interventions in support of SRL have been focused on a single course.

It has also been pointed out that while scaffolding may be important for many students, it can, in fact, even be detrimental to students who already have a high level of intrinsic motivation (Duffy & Azevedo, 2015), and that

scaffolding systems have to give the user a certain amount of control over the amount of support they receive. To make sure that the LA-based interventions do not take over regulation completely and thus act detrimentally on the students' skill progression, hybrid methods have been proposed that share responsibility for regulation between system and human (Molenaar, 2022), an approach that is still in the preliminary stages.

However, most of the research done has been in higher education rather than primary or secondary. The systematic review by Heikkinen (2023) looked at studies of learning analytics interventions to support SRL, and out of 56 studies, only one looked at primary or secondary education. Another systematic review shows that most learning analytics dashboards aimed at supporting SRL seem to be focused on the reflection phase of SRL and provide little or no support for the other two (Jivet et al., 2017).

2 Methodology

This study is the first part of a larger study, where Design-Based Research (DBR) is used for designing support for self-regulated learning in upper secondary education. A very short description of DBR, rephrasing that from a 2012 paper (Anderson & Shattuck, 2012, pp. 16–17) describes it as follows: A study situated in a real educational context, often using mixed methods, that involves iteratively designing and testing an intervention in close partnership between researchers and practitioners. This study identifies what needs pertaining to SRL are suitable for intervention in the form of a digital interface using learning analytics to scaffold students' SRL development, and will act as a basis for the next study, which will concern the iterative process of prototyping that interface.

2.1 Data Collection

The school where this study was conducted is a mid-sized (378 enrolled students at the start of data collection) upper secondary school, called gymnasium in Sweden (three years, starting the year a student turns 16) in the middle of Sweden. The school offers a technological program with a profile of information technology. Most of the students are male, with about 10% female enrollment at the time of the study. The first author of this paper was a part-time teacher at the school in question, which may have increased the response rate. All data was collected anonymously.

Data collection for this study was done in two parts. The first part is data that the school itself collected over 7.5 years from 2015 to 2022, and which consisted of students identifying which skills they most needed to improve. The second part was a survey created and sent by the authors of this paper

to students at the school. The first set of data was collected and analyzed to identify what challenges students find in their studies, and whether those challenges were stable over time. The fact that the existing data had been collected at regular intervals, in the same context and with exactly the same wording over time, provided an opportunity to investigate trends over time. The results of the analysis of the first data then provided the basis for deciding which areas should be focused on in the second data collection, aimed at better understanding the nuances of the problems identified in the first.

The second part of the data collection consisted of a survey, based on the results of the analysis of the data from the school in combination with Zimmerman's model for SRL (2000). The survey consisted of 29 questions, focusing on the most important skills as identified by the students in the first dataset, that are also important aspects of SRL. Four of these questions were about basic information, asking which year they were in, which of the two programs they took, a self-reported average grade, and a question where the students were asked which of three descriptions fit them best. This last question aimed to group the students by how much they perceive themselves to struggle in school, to see if there are patterns in students' answers relating to this perception of themselves. This section was followed by 21 questions divided into the sections *focus*, *planning*, *information*, *engagement*, and *motivation*, where each section had both multiple-choice questions on a scale of 1 (*Never/Almost never)* to 5 (*Always/Almost always*) and open questions.

Table 1

1	To what extent can you focus on your schoolwork during classes?
1a	When you can't focus during classes, what are the reasons for this?
2	To what extent can you focus on your schoolwork outside of class time?
2a	When you can't focus outside of class time, what are the reasons for this?
3	To what extent do you plan your studies?
3a	How do you plan? What information do you use?
3b	If you do not plan, why not?
3c	What support and information do you need to plan your studies better?
4	To what extent do you follow your plans?
4a	When you fail to follow your plan, what do you think is the cause/causes?
4b	Is there any information that you think would help you follow your plans better?
5	To what extent do you believe you have the information you need to develop in the various courses you are taking?
5a	What information do you have today that is useful to you?
5b	What information do you currently lack?

6	To what extent can you feel engaged in schoolwork?
6a	In which situations is it easy for you to feel engaged?
6b	In which situations is it difficult?
7	Do you feel motivated to learn?
7a	When do you feel the most motivated?
7b	When do you lose motivation?
7c	What information could increase your motivation?

Table 1 shows the central questions in the questionnaire, translated to English. Questions with only a number are closed questions. Questions with a letter are open. Questions that were not analyzed for this study have been left out of this table.

2.2 Participants

The first set of data consisted of 9655 answers from a total of 973 students, over 15 semesters (7.5 years).

The questionnaire was sent in early October 2022, with two reminders one and two weeks later. The students could fill in the questionnaire at any time they preferred during the three weeks of data collection, but were also given time during the weekly scheduled class council. Out of the 378 students that received the questionnaire, 224 answered, for a response rate of 59%. The respondents were relatively evenly spread among the years, with 41.1% in year 10, 29.0% in year 11 and 29.1% in year 12. Question number 4 asked the students which of three descriptions best describes them: Persona A "the struggling student", Persona B "the student who does ok but could work more," and Persona C "the student who does well."

2.3 Data analysis

The first data set and the second set's multiple-choice questions were analyzed using descriptive statistics. The open-ended questions underwent thematic analysis using Braun and Clarke's method (Braun & Clarke, 2006), involving six phases: familiarization with data, code generation, theme identification, theme review, theme definition, and report production. The process involved reading the data set, noting initial impressions, coding each answer to capture its essence, and discussing findings among researchers. Codes were revised, grouped into themes with examples, and continuously checked for relevance to research questions. Themes were then mapped, named, and described, ensuring alignment with the underlying data. A heat map was made to visualize theme frequencies (Figure 3) Finally, the findings were discussed in relation to Zimmerman's Self-Regulated Learning (SRL) model, focusing on students' challenges and support needs within the model.

3 Results

3.1 Analysis of first survey

From the analysis of the first survey, two factors stand out that students see as obstacles for their studies, and these two seem stable over time: Planning their studies, and focusing on their school work (figure 2). This result can be seen in both datasets, which will be shown in greater detail below. The reasons for these obstacles vary (figure 3), but again some stand out. The obstacles to focusing are primarily external factors like noise or other people disturbing them, along with electronic devices, and internal factors like tiredness and lack of motivation. More details about these factors will be presented in the sections below. The latter two categories are the most commonly occurring answers overall in the data. Another commonly reported obstacle is lack of knowledge about the planning process itself.

As for the second research question we posed, the major factors seem to be lack of information, lack of clarity in the information they do have available, and lack of information regarding how they should progress in their studies.

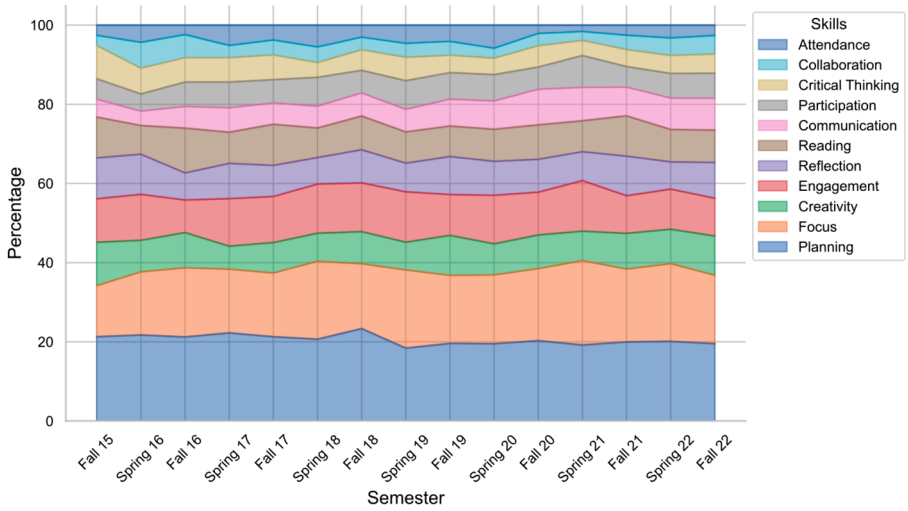

Figure 2
Chosen skills as percentages of all answers, by semester

Skills chosen illustrated with an area graph. Note that each student chose three skills. Approximately 20 % of choices were planning, which comes out to roughly 60% of students having chosen planning as one of their three each term. Y-axis: Share of the total number of answers given, adding up to 1 (100%).

Theme	Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
1. Internal distractions	1.1 Tiredness 161	1.2 Lack of motivation 121	1.3 Difficulties focusing 81	1.4 Hunger 5	1.5 Psychological reasons 76	
2. External distractions	2.1 Other people 70	2.2 Sound or volume 47	2.3 Electronics 92	2.4 Other priorities 81	2.5 Other distractions 21	
3. Information available	3.1 Learning platform 36	3.2 Temporal information 98	3.3 Other people 19	3.4 Formal information 33	3.5 Personal knowledge related information 13	3.6 Planning related information 5
4. Information needs	4.1 Information needs 76	4.2 Need for clarity in information 83	4.3 Personal knowledge-related information 22	4.4 Personal development-related information 59	4.5 Planning-related information 10	4.6 Information organisation 17
5. Support for planning	5.1 Tools 39	5.2 Needs for planning 70	5.3 Needs for execution 21			
6. Motivational needs	6.1 Utilization of knowledge 34	6.2 Other motivational factors 6				

Figure 3

Themes and categories identified in the survey data, with number of occurrences of each category in the lower right corner of each cell. Cells are formatted on a red-yellow-blue scale. with red for highest number of occurrences and blue for lowest.

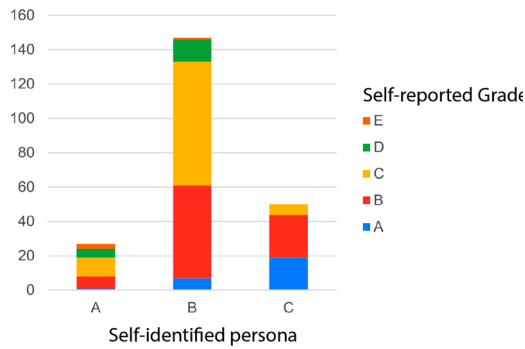

Figure 4

Students by self-identified persona, stacked by self-reported approximate grade where A is the highest grade, and E is the lowest passing grade. It can be noted that there are few low-performing students in this data set.

3.2 RQ1: What challenges do students experience in the process of regulating their own learning?

Looking at this in more detail, we can see that both the first set of data, which the school itself has been collecting over the years, and parts of the data collected specifically for this study provide answers for the first research question.

The data from the school ranges from the second half of 2015 until the second half of 2022 for 15 terms of data in total; there is a very stable trend (figure 2). At every point in the time covered, the skills planning and focus are the two most commonly chosen skills that students declare a need to develop. The fractions for the different skills are mostly the same over the three years of the students attending the school (figure 5), with little change in chosen skills at group level from starting the school to graduating three years later. There is a sharp decline in how many students reply to the questions in the system in the sixth and last semester, from 1464 data points for the fifth semester to 564 in the sixth and last. Among the eleven skills that are presented to the student, three clearly map to the three phases of SRL: Planning as part of the forethought phase, focusing as part of the performance phase, and reflection as part of the self-reflection phase, which means that for the students attending this school, there are clear problems relating to the forethought and performance phases. Based on this analysis, the questionnaire developed for the second part of data collection was focused primarily on planning, focus and engagement as the main components that stood out.

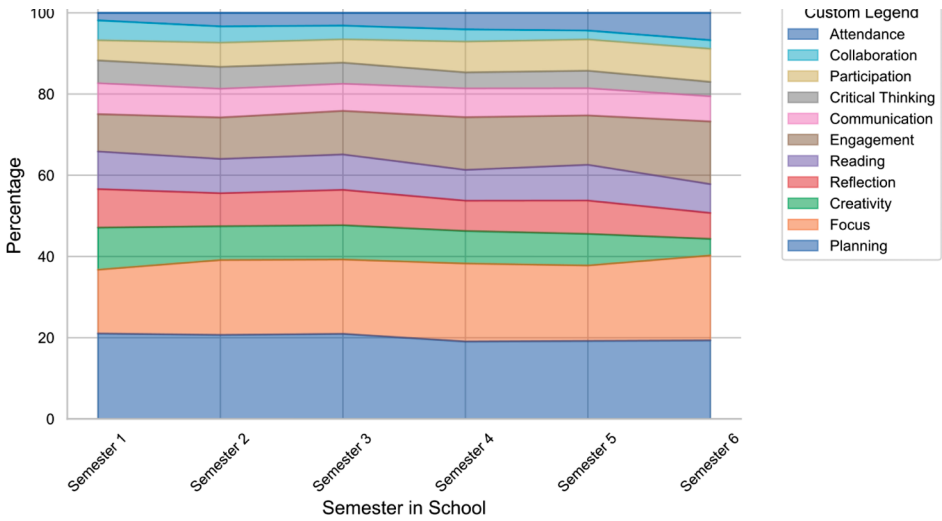

Figure 5
Chosen skills as percentages of all answers, by semester in school

Like Figure 1, but by term 1–6 of the pupils' three-year education, i.e. 1 is for the answers from the first semester of year 10, 6 is for the second semester of year 12. Y-axis: Share of the total number of answers given, adding up to 1 (100 %).

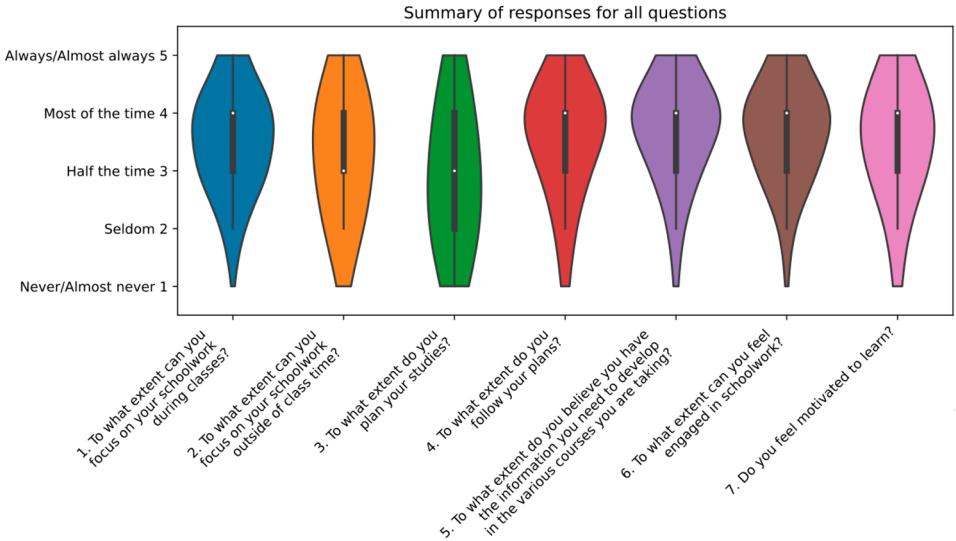

Figure 6a

Answers to multiple-choice questions. Question number 4 was optional. X-axis: Questions 1–7, see Table 1. Y-axis: Answers on Likert scale from 1 (Never/Almost never) to 5 (Always/Almost always).

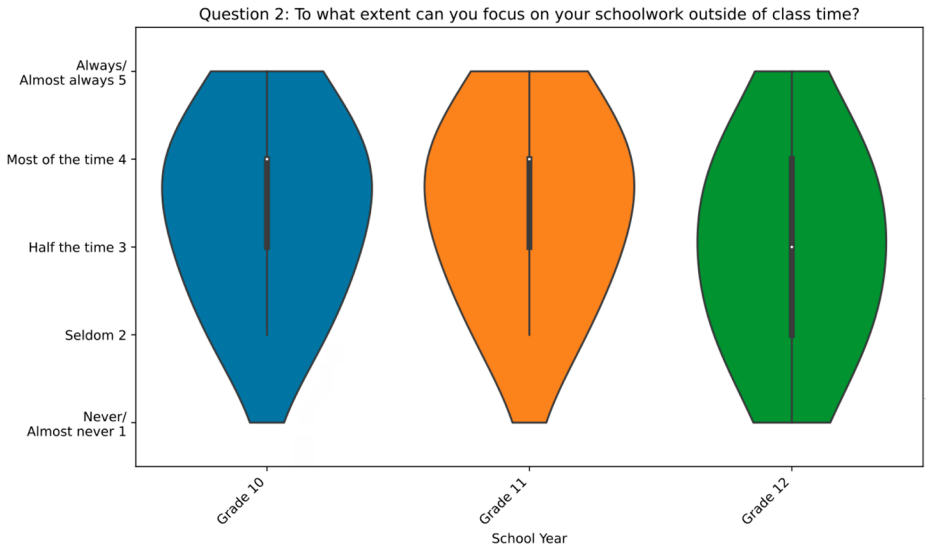

Figure 6b

Question 2 according to school year 1–3 on X-axis.

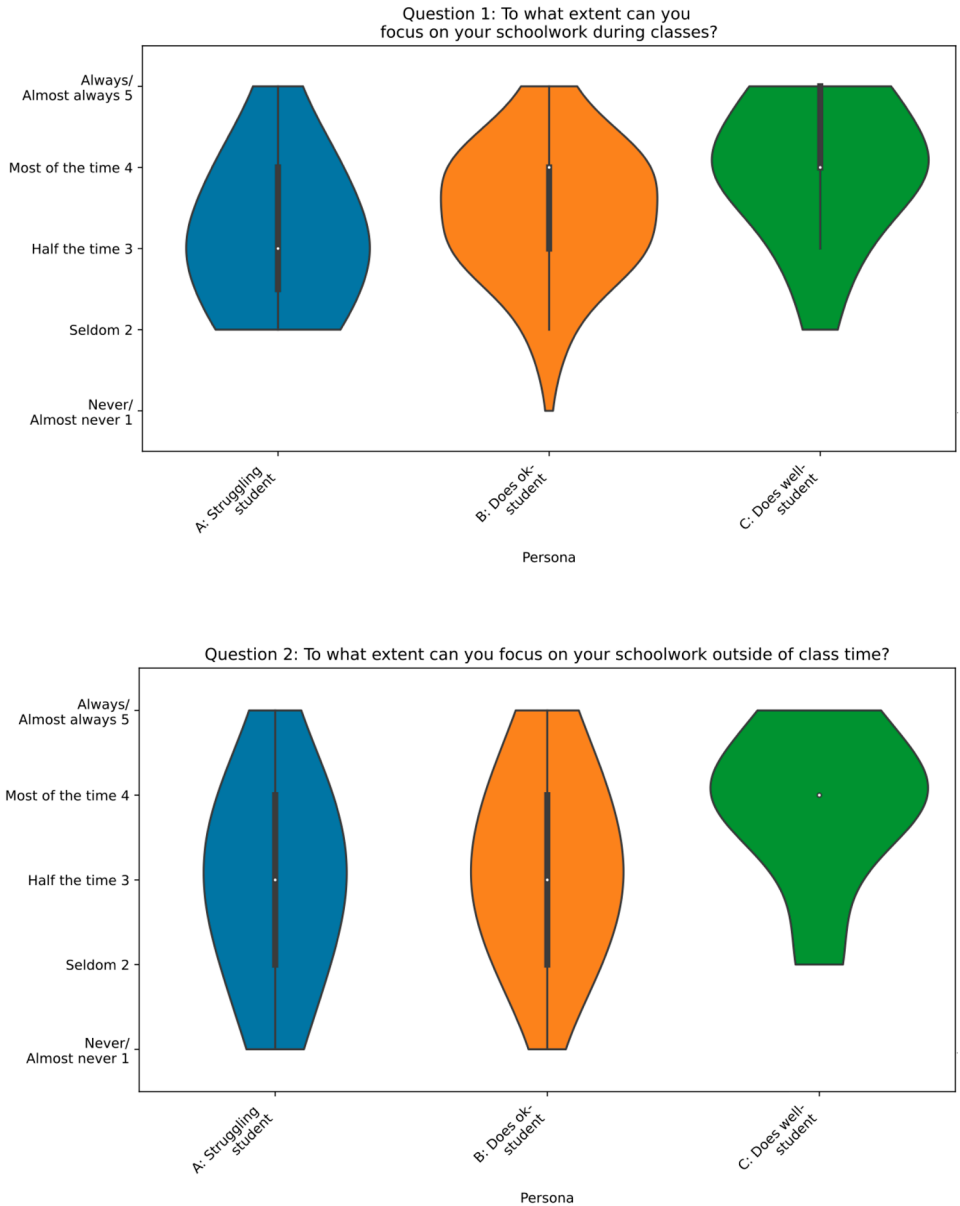

Figure 7

Answers to question 1 (top) and question 2 (below) according to persona (X-axis). Y-axis is the same Likert scale as Figure 6.

There were seven multiple-choice questions on a Likert scale asked in the questionnaire. The distribution of answers can be seen in Figure 6, where we can see that while many students answer 4 or 5, there is a large group of students that have trouble in these areas. Questions 2 and 3, about focus outside of class and planning, respectively, have the lowest score, which corroborates the results from the retrospective data analysis. The difference between the answers to questions 1 and 2 are noteworthy, as it means students have an easier time focusing on schoolwork in class than at other times. In the diagram on the right, we can also see that focus out of class is similar for years ten and eleven, but that year twelve has a harder time. Looking at Figure 6 we can see the question about focus as it relates to the different personas we asked the students to identify with. Persona C students clearly have an easier time focusing in either setting than the others, and there is not much difference in their ability to focus in class or out, while personas A and B have a harder time focusing, especially outside of class.

Theme	Category 1	Category 2	Category 3	Category 4	Category 5
1. Internal distractions	1.1 Tiredness 161	1.2 Lack of motivation 121	1.3 Difficulties focusing 81	1.4 Hunger 5	1.5 Psychological reasons 76
2. External distractions	2.1 Other people 70	2.2 Sound or volume 47	2.3 Electronics 92	2.4 Other priorities 81	2.5 Other distractions 21
5. Support for planning	5.1 Tools 39	5.2 Needs for planning 70	5.3 Needs for execution 21		
6. Motivational needs	6.1 Utilization of knowledge 34	6.2 Other motivational factors 6			

Figure 8
Themes and categories related to RQ1

For better insight into these problems we can look at the result of the thematic analysis, where themes 1, 2, 5 and 6 provide some answers to our first research question.

Theme 1: Internal distractions

By internal distractions we are referring here to what causes the student to become distracted from their current task, where the students answer in ways that place the source mainly within themselves. Four separate categories were identified within this theme. Category 1.1 is **Tiredness** (161 occurrences), and consists mostly of answers stating just that, either in just the one word,

or with some context, for example "*I'm too tired"* (question 4a), "*when I'm too tired,*" or "*haven't slept enough*" (question 1a), or "*I usually procrastinate because I don't have the energy to do it. It also takes longer to do it (even though I would probably save time by planning).*"

Category 1.2 is **Lack of motivation or interest** (121 occurrences), which typically consists of answers like "*it's boring*" or "*I'm not interested in the assignment*" for question 1a, but like tiredness, these kinds of answers appear in response to several questions. In reference to lack of planning, we find answers like "*I should, but I don't feel like it,*" and "*it never works to plan more than a few hours ahead, because suddenly you get an assignment in the last class that is due earlier than the assignment you had planned to work on.*" 1.3 **Difficulties focusing** (81 occurrences) is mainly about questions 1a and 2a, and relates to different ways that the students encounter problems in focusing on the task at hand: "*zone out,*" "*my brain wanders,*" "*I procrastinate*" are typical answers. 1.4 **Hunger** (5 occurrences) consists of a few answers to question 1a, about lack of focus during lessons. Category 1.5 **Psychological reasons** (76 occurrences) is the final category in the first theme, and consists of answers relating to psychological reasons other than the ones covered by other categories. This means for example stress, depression or simply forgetfulness.

Theme 2: External distractions

With external distractions we mean those which distract the students from their tasks where the student identifies a source other than themselves. The first category here is 2.1 **Other people** (70 occurrences). In the school (question 1a) this tends to be about other students, from simply "*classmates*" or "*friends who are unfocused,"* to the more specific "*when students from other classes come into our lesson and disturb us.*" This category also appears in relation to question 2a, where the answers center around friends, but are also about family "*I need to help out at home,*" or "*people (mostly family) need me to do stuff every 20 minutes.*" The next category, 2.2 **Sound or volume** (47 occurrences) are mostly about disturbing sounds, or about the noise level being too high in the classroom. "*People talk too much," "it's too loud."* A category that doesn't come up as much as a source of distraction inside the classroom, compared to focusing outside the classroom is 2.3 **Electronics** (92 occurrences). By this we mean answers about mobile phones, computers, games or the like. Most answers in this category are simply those: "*Games*," "*YouTube*," "*my phone*". In category 2.4 **Other priorities** (81 occurrences) we find answers where the student makes clear that they make a choice to focus on other things, like "*I want to do other things*," "*going to the gym,*" "*exercising,*" or "*work.*" Finally, the last category, 2.5 **Other distractions** (21 occurrences) is a category for those answers that are too unspecific to fit in the other categories. Most of these simply state "*distractions*" or "*other stuff*".

Theme 5: Support for planning

The fifth theme we call Support for planning, and here we collect answers that relate to the active task of planning. The first category in this theme is 5.1 **Tools** (39 occurrences), which consists of answers that are about which tools students use, or would like to use, for their planning. Among these we mostly find digital calendars, the learning platform, other digital tools or in a few cases physical calendars or paper. The second, and largest category is 5.2 **Needs for planning** (70 occurrences), which relates to those answers pointing out needs to improve the planning process, such as "*some information about the most effective ways of planning, facts about circadian rhythms and times of day when you work efficiently, etc.*," "*that someone explains how one should prioritize and plan,*" and "*how to study best in different subjects*." In this category we also find a group of answers relating to goal setting, for example "*a clear goal and where I am in relation to that goal*" and "*how to create goals that suit you*". Finally, the category 5.3 **Needs for execution** (21 occurrences) consists of those answers that call for support in the execution of the plan, such as "*a system that forces me to work,*" or "*automatic notifications that remind me of what happens next week and that reminds me to do school work at home*."

Theme 6: Motivational needs

The sixth theme is motivational needs. By this we mean answers where students point out things that they feel that they would need in order to be better motivated for doing school work. This consists of two categories, where the first one is 6.1 **Utilization of knowledge** (34 occurrences), which consists of answers that ask for the knowledge they are meant to acquire in school to better be related to real world applications. "*Use what you do for something practical that I can actually have use for,*" "*areas of use for what I learn and connections between all the things I learn*." "*Things that make the world better*." Finall, 6.2 **Other motivational factors** (6 occurrences) is a category consisting of a few answers in the vein of competitions, or more challenges.

3.3 RQ2: What information and data do the students need in order to better regulate their own learning?

For RQ2, we mostly look to the thematic analysis, where the main result is that while students do report that they have access to and use information, mostly information about test times and deadlines, they also report a need for this same kind of information, suggesting that the temporal information they have access to is incomplete or inconsistent. They also ask for clearer information, and for information about the planning and study process itself.

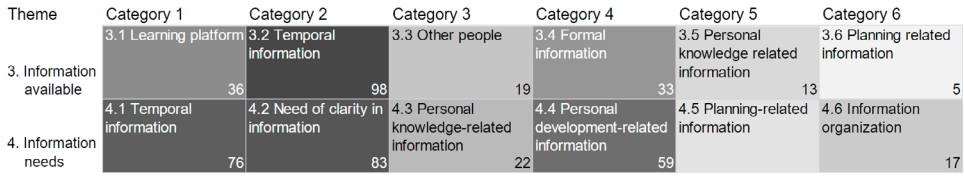

Figure 9
Themes and categories related to RQ2

Theme 3: Information available

The third theme is about answers related to what information the students have and utilize today for planning and for their own development. The answers fall into six different categories. 3.1 **Learning platform** (36 occurrences). Several students point to the learning platform used at the school (Canvas) as a source of information, but the main sources of information seem to be the ones falling into category 3.2 **Temporal information** (98 occurrences), where students point to the school calendar. "*Schedule,*" "*school calendar*," "*I use a digital calendar*" are among the answers here. Some students answer that they get information from "*other students*" or a "*teacher that reminds us when we have a deadline*," which we categorize as 3.3 **Other people** (19 occurrences). As 3.4 **Formal information** (33 occurrences) we have categorized answers that bring up formal documents like grading criteria, course plans or course books as sources of information. In category 3.5 **Personal knowledge related information** (13 occurrences) we have some answers that mention that the students use information such as preliminary grades and feedback from teachers for their personal development, and finally we have a few answers that fall into the 3.6 **Planning related information** (5 occurrences), which is about tips for studying, or the school's work with study technique.

Theme 4: Information needs

The fourth theme is about what the students themselves identify as information they need, either for planning, for their own development, or for motivational reasons. The first category here is 4.1 **Temporal information** (39 occurrences), which identifies the need for information about deadlines and tests. Some of these only say "*deadlines*," while others are more specific, such as "*telling us what to hand in and when and do it in advance and not a few days before deadline.*" The largest category in this theme is 4.2 **Need of clarity in information** (70 occurrences). "*Examples of solutions*," "*clearer assignments*," "*that the teacher is clear about what should be studied and the amount of studying timewise so that you can plan accordingly. Also remind that you should study,*" and "*much clearer guidelines for what one should be able to do for attaining a specific grade,*" are some of the answers fitting into this category.

We then have two categories that are closely related, which we call 4.3 **Personal knowledge-related information** (22 occurrences) and 4.4 **Personal development-related information** (59 occurrences). In these two categories we have student answers that bring up the need for information about what knowledge level or grade level the student is currently at (4.3), and information about what they need to do to advance their knowledge and skills (4.4). Some variation of "*how am I doing?*"[1] is the most common need pointed out here. This information can also be related to Figure 4.9, where we can see that it is primarily persona A students who feel that they don't have enough of this kind of information. 4.5 **Planning-related information** (10 occurrences), consists of answers that point out the need for information that is vital to planning, such as the scope of the assignment, or how important that assignment is for the course grade. Finally, we have the category 4.6 **Information organization** (17 occurrences), which are requests for information to be

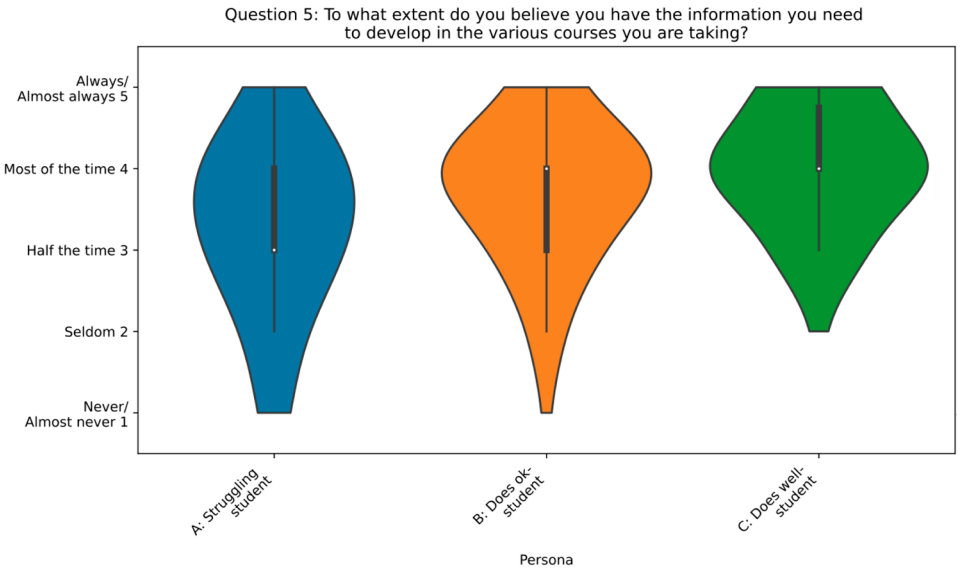

Figure 10
Question 5 (To what extent do you believe you have the information you need to develop in the various courses you are taking?) arranged by persona.

[1] In Swedish: "Hur jag ligger till". The Swedish expression is more clearly referring to a result, in this case a grade, than may be clear from the English translation.

organized in a better way than currently, "*some easy digital tool where everything is collected in the same place,*" "*one place where all the week's homework and tests are written. In one place, not spread out on a webpage where I have to search for things.*"

4 Discussion

4.1 Challenges that students experience in the process of regulating their own learning

The analysis shows that students face a number of different challenges when regulating their own learning, especially in the planning and performance phases, stressing the need for supporting these phases, which may be lacking proper support in existing learning analytics platforms (Jivet et al., 2017). The major factors can be found in the two themes internal and external factors, where the internal factors like fatigue, lack of motivation, and psychological health are the most common obstacles the students face. In relation to psychological health, this is a pressing issue in need of addressing, but it is outside the scope of this study, and as such will not be addressed in detail. Among external factors, it is clear that the two main challenges are the actions of other students in the classroom, and electronic devices, especially mobile phones, outside the classroom. There are, of course, synergies between these to take into account. It is naturally more difficult to be motivated when you are very tired, and all of the internal factors can exacerbate the distractive nature of electronic devices. It has also been suggested that learning analytics in supporting learning can also increase motivation (Aguilar et al., 2021) Finally, one challenge mentioned by several students (see Fig. 9), is that the students simply don't feel that they know how to plan, or how to study, which is in line with Winne's research about students' needs for better tools and knowledge about how to regulate their learning (Winne, 1995, 2005, 2022).

When looking at how the results differ by persona, the most striking result is that persona C is quite stable across all the different questions, while personas A and B have clear problems with both planning and focus, suggesting that the issues that students face are not limited to a small group of students, but that it is rather a small group of students who are doing well when it comes to regulating their learning, while the majority struggle.

4.2 Information students need to support their learning

The data that the students need is primarily 1) information about tests and deadlines, 2) clarity about information and assignments, and 3) how to improve in their school subjects. While the students report that they do have access to information of type 1 that they use for planning, it is currently incomplete, inconsistent, and spread out across different channels and platforms. Even

more than temporal information, students report a need for increased clarity in information, saying that they often don't understand the task nor what is required or expected of them. The third type of information needed is information about what they as students need to improve upon and how to improve. This is all information that is generally provided by teachers. Further, the data the students acquire could be scaffolded through technologies.

It has been shown that learning analytics can provide feedback that helps students with what they need to focus on to improve (Afzaal et al., 2021b), and it should be quite possible to build systems that can ease the process of communicating both information and the lack thereof. As for the clarity of information, it should be quite possible to take advantage of the recent growth in generative AI to accommodate the need for clarification and examples that students signal, as exemplified recently by Mollick & Mollick (2023). Students also suggest that they need prompts, or notifications, to help remind them and push them into action, another area that should be perfectly suitable for learning analytics.

4.3 Balancing needs and wants

Some students' answers (see e.g. Theme 4: information needs above) seem to place the full weight of improving their existing situation on the teacher, seemingly abdicating from regulating their learning and preferring the teacher to do the regulating. This is a dangerous road to take if the goal is to improve the student's self-regulation. Others put the full responsibility on the students themselves which, considering the number of students who have problems with the current situation, seems an unproductive stance to take. Winne (2022, p. 775) claims that "learners need to be able to perform learning tactics and strategies without undue effort. Otherwise, excessive cognitive load or inept execution of those skills would worsen rather than enhance progress on academic tasks." This, combined with the earlier mentioned suggestion that too much scaffolding harms the students' regulatory skills (Duffy & Azevedo, 2015), suggests that addressing the needs identified by the student has to be balanced so that they can scaffold the students in what they need without taking over the task of regulation.

4.4 Limitations of the study

This study was conducted at a single school, with a limited number of students who had all chosen the same programme. This was due partly to the existing data, which had been collected at this particular school, and unfortunately not in a broader context. It would be valuable to see if the long-standing trends at this one school can also be found at other schools and within other programs. This limitation means that several groups of students are

underrepresented, or not represented at all, such as the lowest-achieving students who don't have the grades necessary to get accepted into that school. Further, the school has an IT focus, and many such schools have an underrepresentation of female students. The methodology of analyzing anonymous survey data also has its limitations, in that we are not able to ask for clarifications or follow-up questions when we get answers that lead us to further questions. The chosen method of looking at long-term trends in existing data to provide the focus for further investigation was a rewarding choice in this study and put the research more in line with the needs of the teaching profession, but it also means we may have missed important aspects that were not part of that long-term data.

With these limitations, it is imperative that these results are not taken as generalizable to secondary students at large, but it is our hope that what we have seen here can provide insight and knowledge that can be applicable in similar contexts.

Conclusions and implications

The implications of this study can be divided into two main areas: Implications for educational practice, and implications for systems design. The practical implications of these results are that secondary education does need to improve its working environment to minimize distractions, in accordance with previous research (Schmidt, 2020), and that there is a lot of work that needs to be done about the psychological health of secondary education students. There is also clear support for more explicit instruction on how to regulate learning, in line with the findings of Dignath & Veenman (2021). Lastly, students find that information is fragmented, inconsistent and unclear, which is an area where systems design can help, but which is at its core also something that educational practitioners have to consider.

When it comes to the implications for systems design, there is a pressing need for systems that not only communicate information from teachers to students, but also augment that information with analytics to support students where the existing information flow is lacking. This is in line with previous research. However, findings from this study highlight that while trace data of student activities and regular learning analytics methods often used (e.g. Heikkinen et al., 2023; Winne, 2022) are important, there are other areas that may need other techniques to address the need for organizing and clarification of existing information. This is an area where recent advances in AI, specifically large language models, may be helpful. This is a direction for research that would be important to investigate further. Systems need to be designed with the students' regulatory processes in mind, and with

built-in support for scaffolding self-regulation, since our results suggest it may be quite difficult not only for some, but for the majority of students. Support for the planning and performance phases seem to be the most crucial, where planning, adhering to the plan and adapting plans to changing circumstances stand out as the most challenging parts. In previous research, Jivet et al. (2017) found that few interventions targeted the planning phase, while Heikkinen et al. (2023) found 45% of the studies they look at supporting this phase, suggesting that there has been improvement in the attention to planning, but that it may still need more attention considering its importance to students, as shown in our results.

As for further research implications, we see that there is a need to look at how systems for secondary education can be designed in an integrated manner, in line with Jivet et al. (2017), to support the full range of needs found in this study, as well as studying the effects of such a system to make sure the scaffolding is designed in such a way that it supports the development of students' regulatory processes and does not replace them. Most of the research in this field is limited to higher education (Heikkinen et al., 2023; Schwendimann et al., 2016), calling for more research looking at what aspects of learning analytics support for students also translate to secondary education.

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